

Armed Forces College of Medicine
AFCM





Functional Areas of Cerebral Hemispheres

BY
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Intended Learning Outcomes

By the end of this lecture , the student will be able to:

1. **Locate** **the main functional areas of the cerebral hemispheres.**
2. **Predict** **effect of lesion in any of these areas.**
3. **Define** **cerebral asymmetry & cerebral dominance.**



KEY POINTS OF LECTURE

1) Functional areas of FRONTAL lobe and the effects of lesion

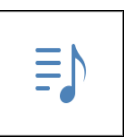
2) Functional areas of PARIETAL lobe and the effects of lesion

3) Functional areas of TEMPORAL lobe and the effects of lesion

4) Functional areas of OCCIPITAL lobe and the effects of lesion

Functional Areas

The Frontal Lobe



Frontal lobe

Precentral area
Motor areas

- 4
- 6
- 8
- Broca's 44,45

Prefrontal area



Central sulcus



Motor area

Sensory area

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Area 6

Area 8

Area 4

Prefrontal Area

Area 44 & 45

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Area 4
Primary motor area

site

representatio

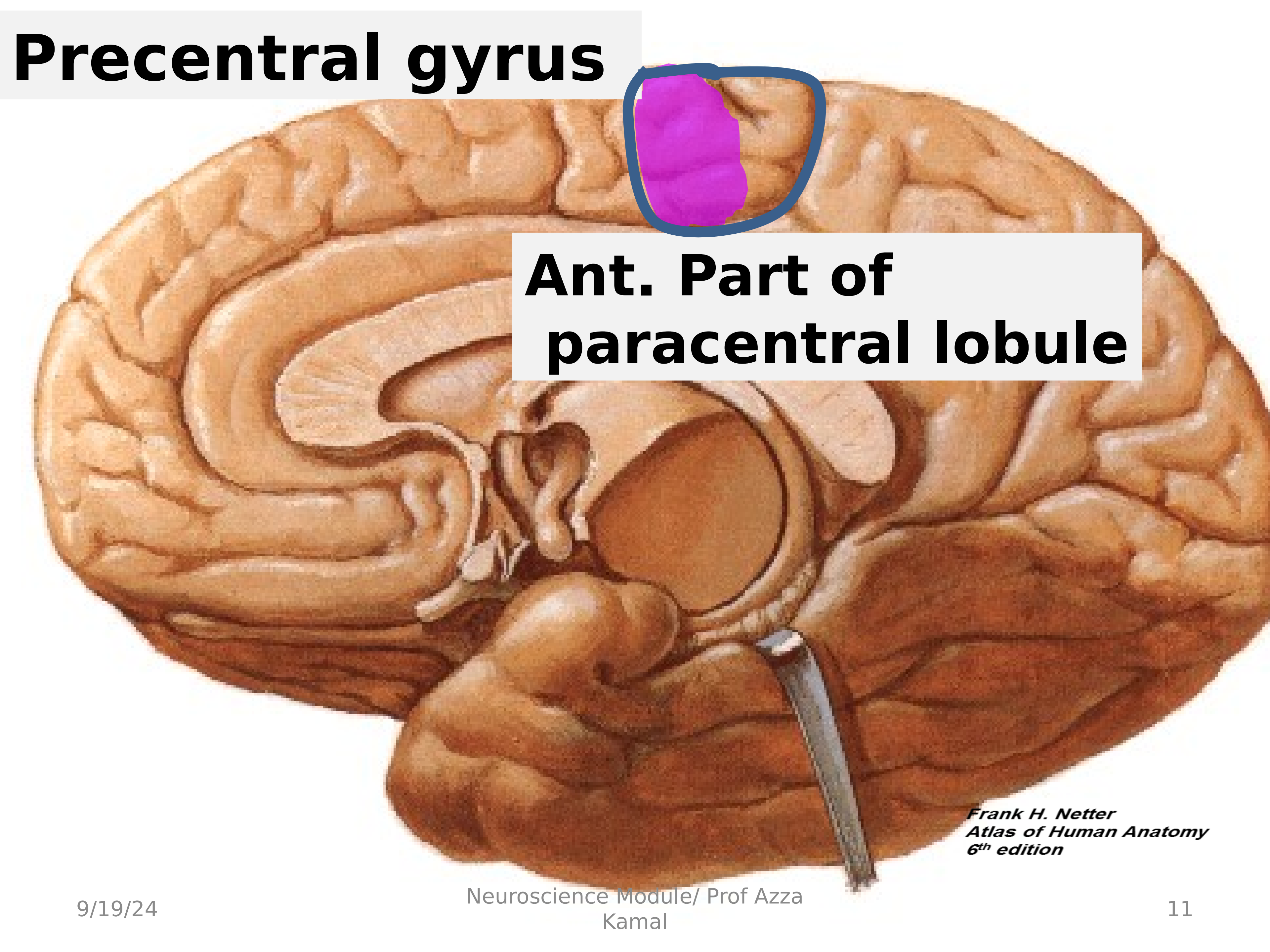
function

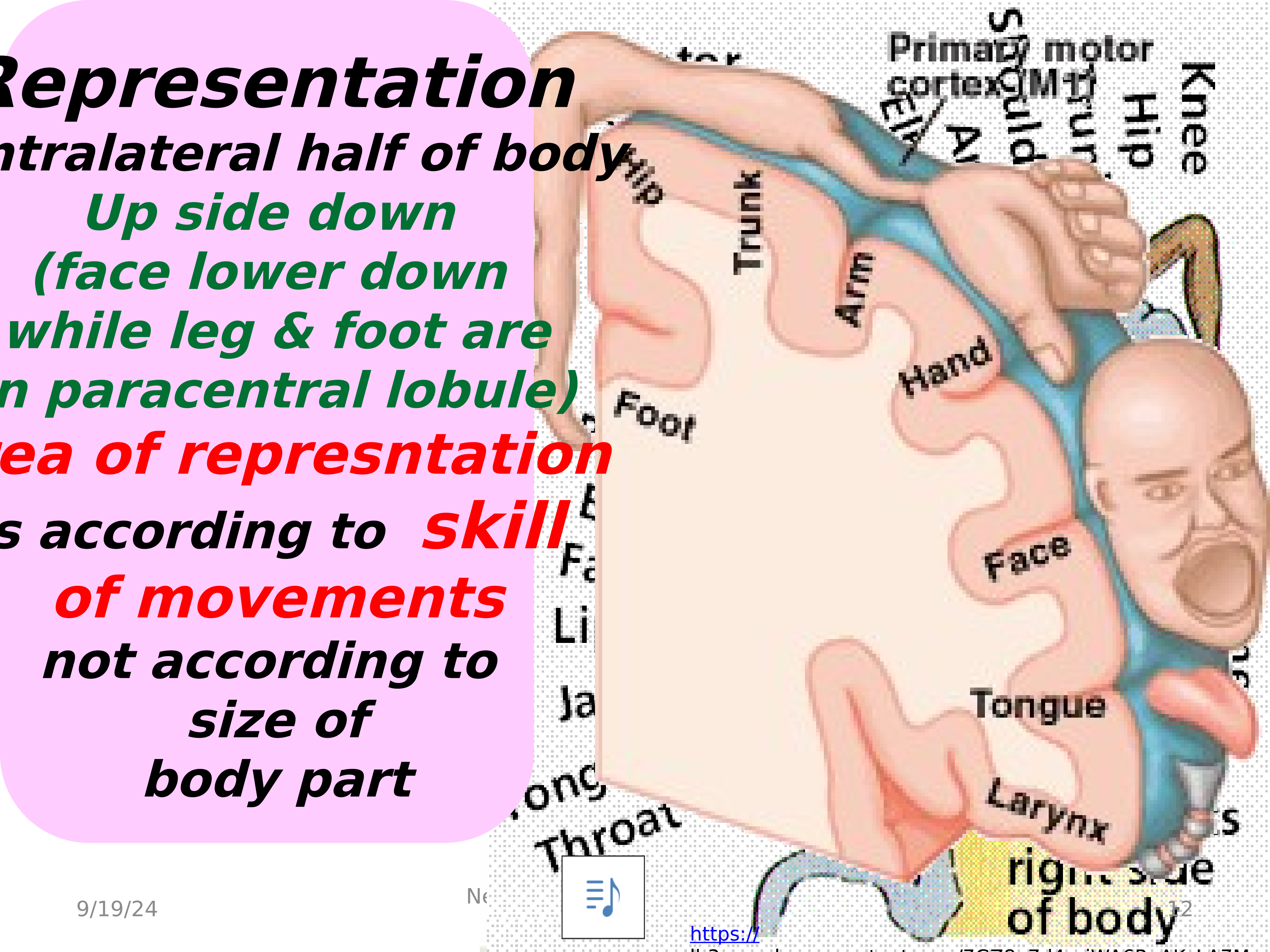
lesion



Area 4 (Primary motor area) :

- **Site:** Precentral gyrus & ant. part of paracentral lobule.
- **Body representation:** it contains a map of contralateral ½ of body represented upside down (motor homunculus) so face is lower down & leg and foot in paracentral lobule.
- **Representation is proportionate to skill;** so parts with fine skilled movements e.g. hands occupy larger areas.
- **Function:** initiates discrete voluntary

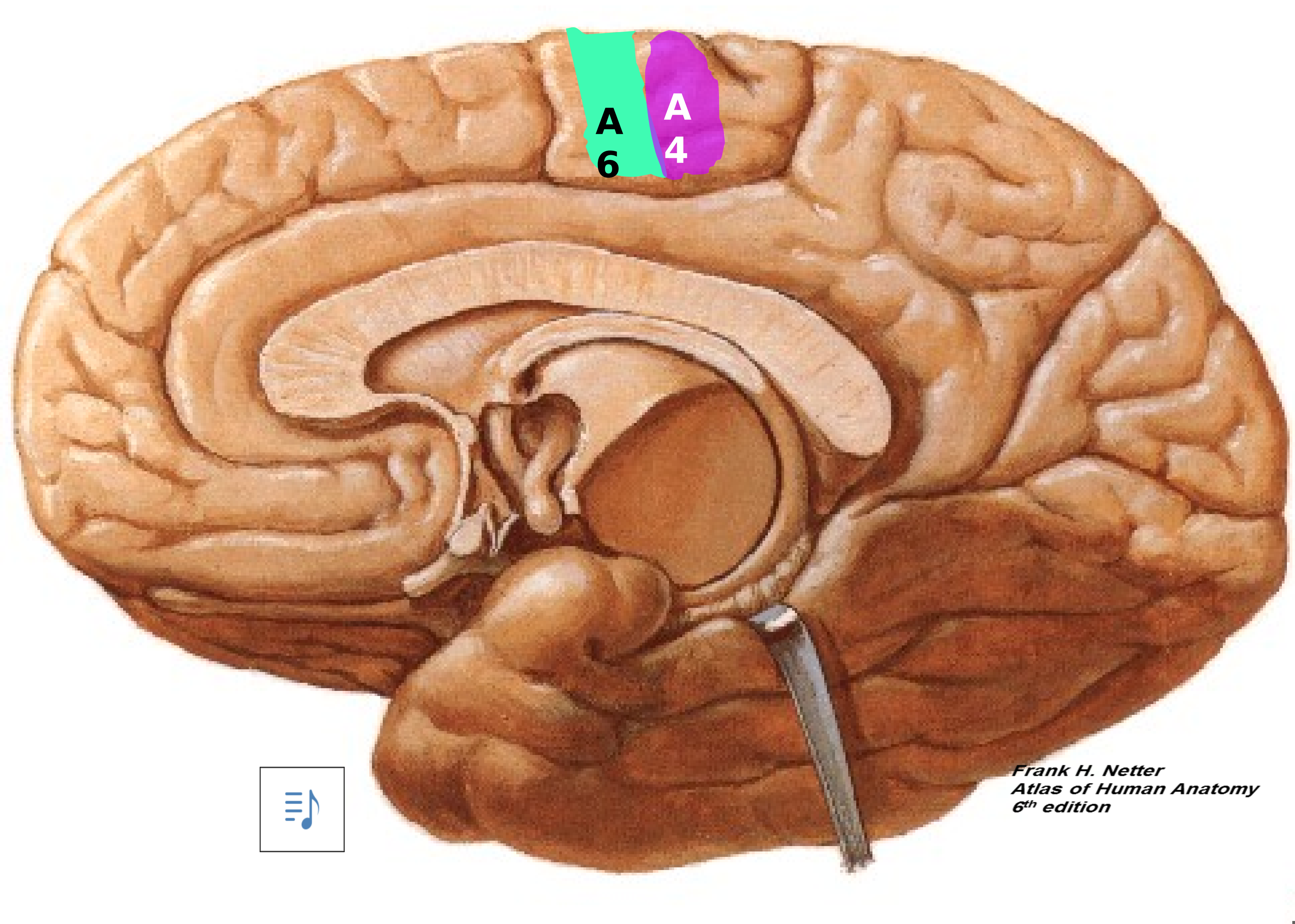

Precentral gyrus
Ant. Part of paracentral lobule
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Representation
ntralateral half of body
Up side down
(face lower down
while leg & foot are
n paracentral lobule)
ea of represntation
s according to skill
of movements
not according to
size of
body part
Primary motor
Knee
Hip
Hip
Trunk
Arm
Hand
Foot
Face
Tongue
Larynx
Throat
of body
https://

Premotor Area 6

- **Site** → **infront of area 4 in sup., middle & inf. frontal gyri + extends on med. surface**
- **Functions** → **plans the movement & stores the plan. It adjusts the posture to start the movement. It inhibits muscle tone & grasp reflex.**
- **Lesion** → **awkwardness of movements "apraxia" , spasticity of muscles & reappearance of grasp reflex**


A
6
A
4
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ea 8 (frontal eye fiel

- ❑ Site infront of area 6 in sup. & middle frontal gyri
- ❑ Function voluntary conjugate eye movements. Its stimulation leads to contralateral deviation of both eyes.
- ❑ Lesion 1) ipsilateral deviation of both eyes towards side of the lesion

  2) inability to turn eyes to opposite side

Reflex conjugate eye movements not affected since it is controlled by occipital eye field



Area 6

Area 8

Area 4

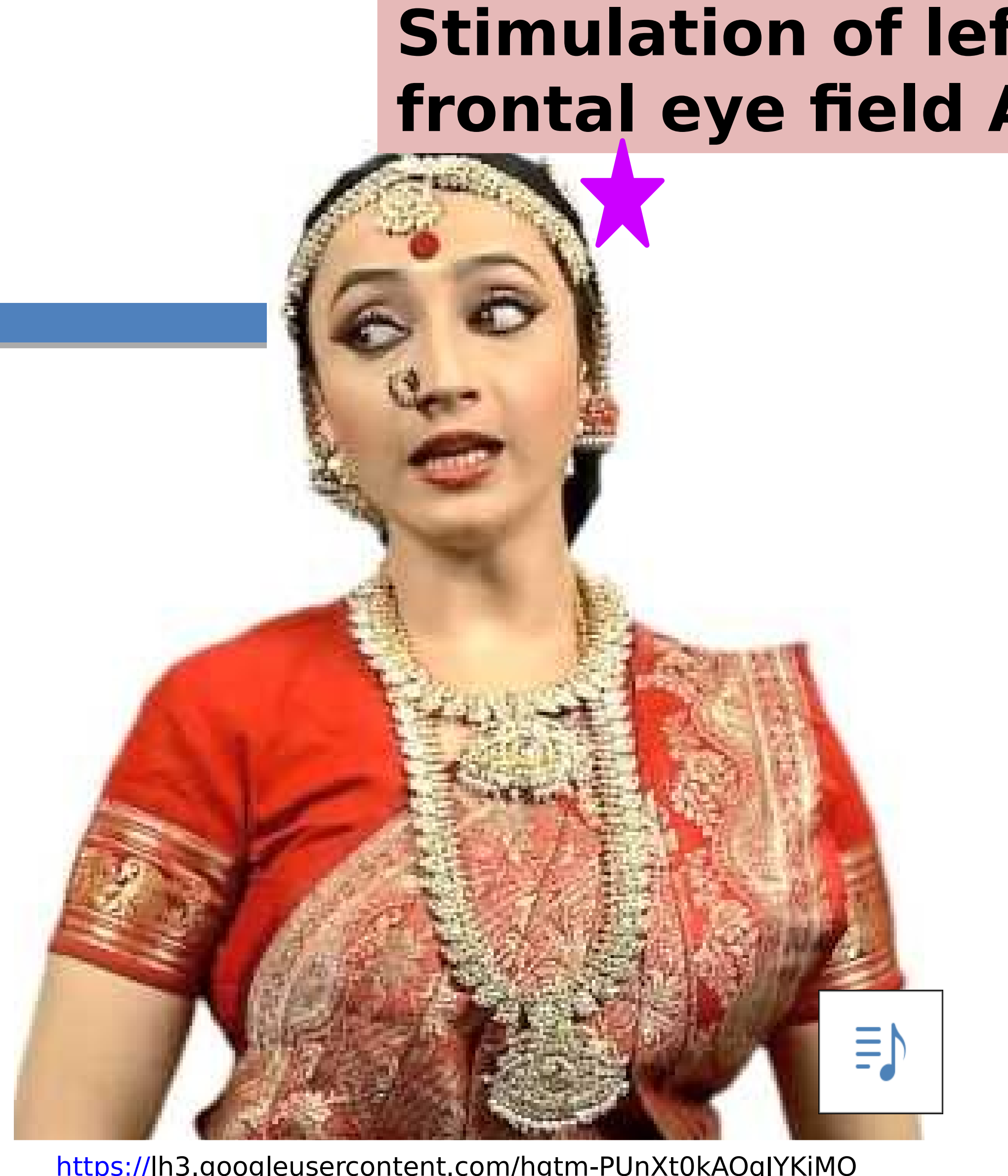
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Eyes deviate to the right

Function

ontal eye field A8

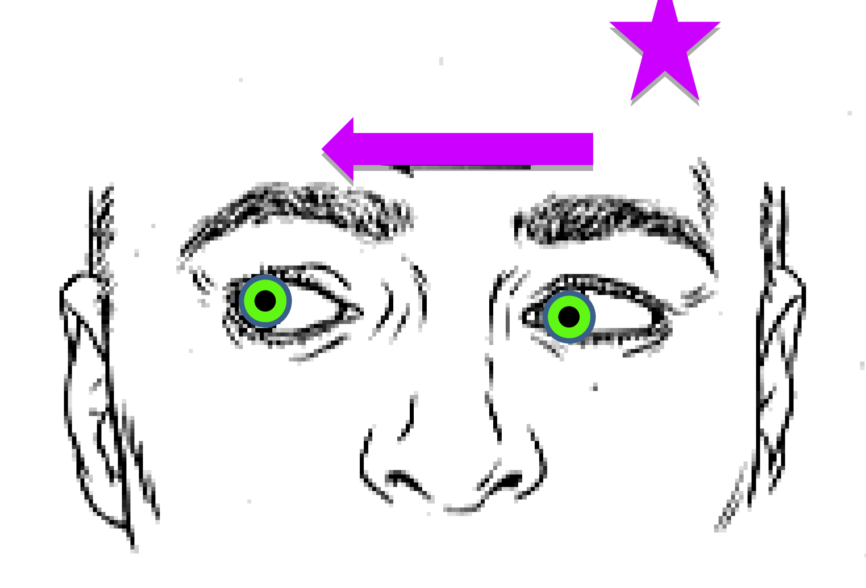
Responsible for
luntary conjugate
Eye movement
Contralateral
viation of
th eyes

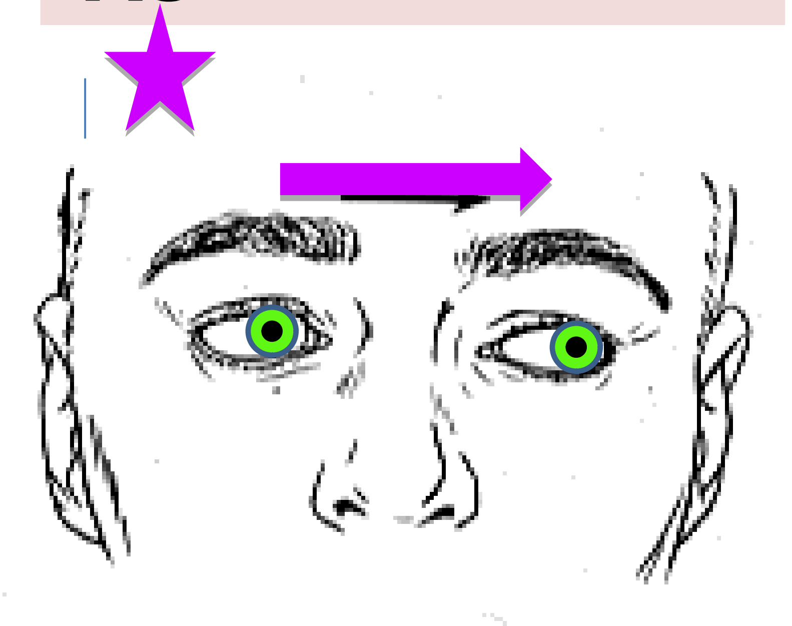


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Frontal Eye Field A8

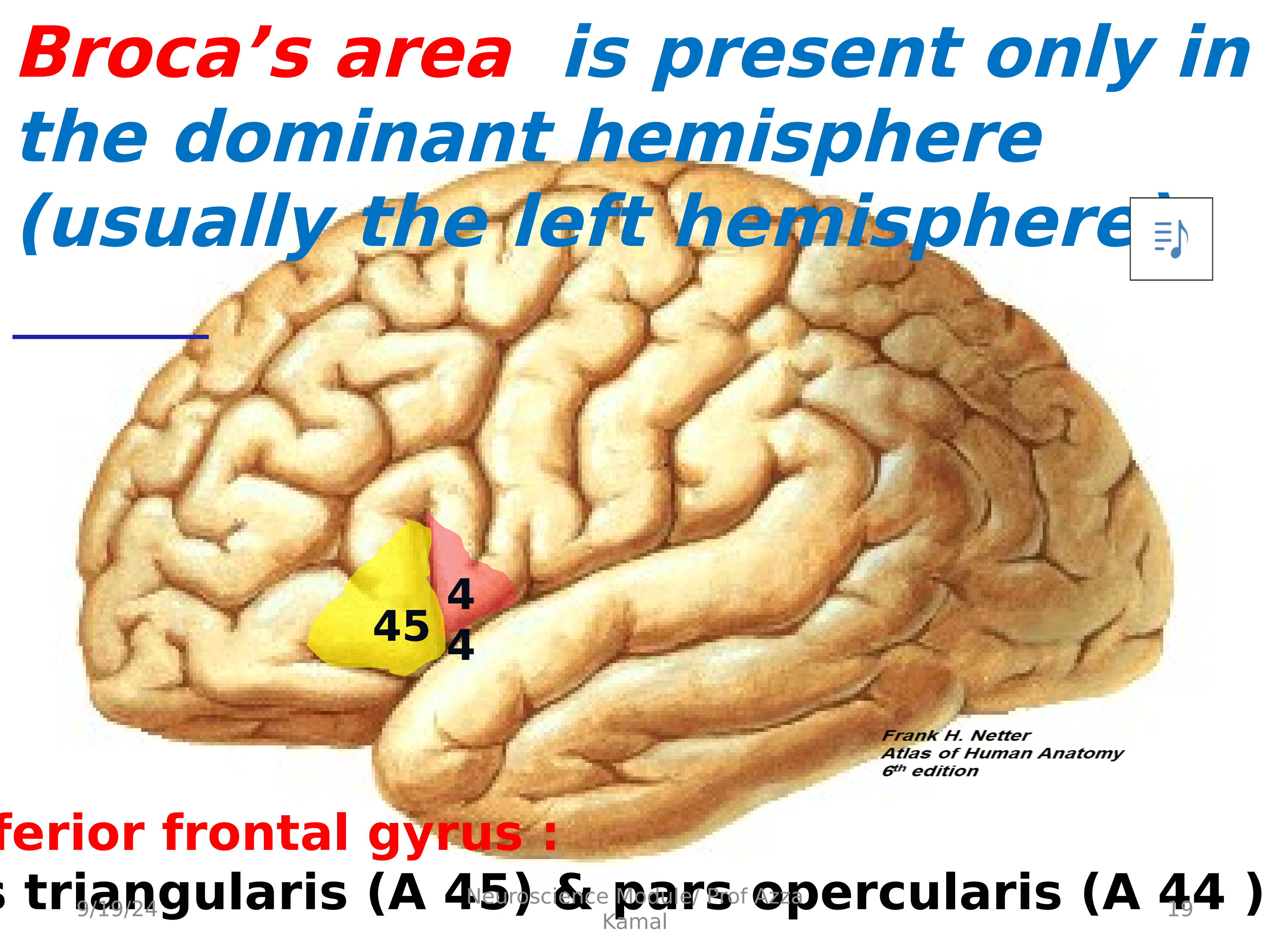
Frontal Eye Field A8





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Broca's area is present only in the dominant hemisphere (usually the left hemisphere)
45
4
4
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ferior frontal gyrus :
s triangularis (A 45) & pars opercularis (A 44)
9/19/24
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19

Function

Broca's area

(motor speech area)

Responsible for production of intelligible words

(لـغة مـفهومه)

Programs sequence of muscle contrac
to produce intelligible sounds (words)

then send these orders to the near
motor area 4

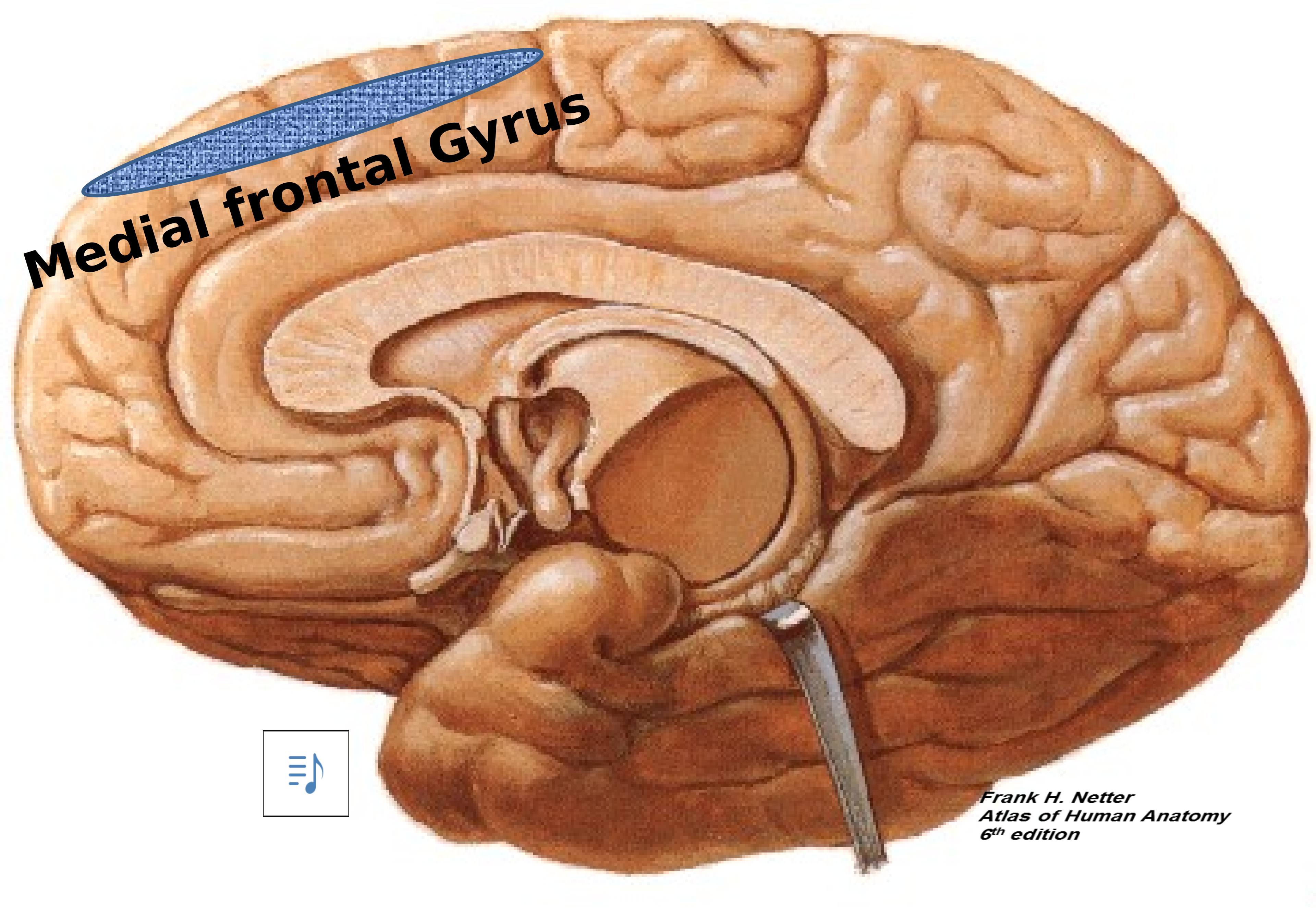
44

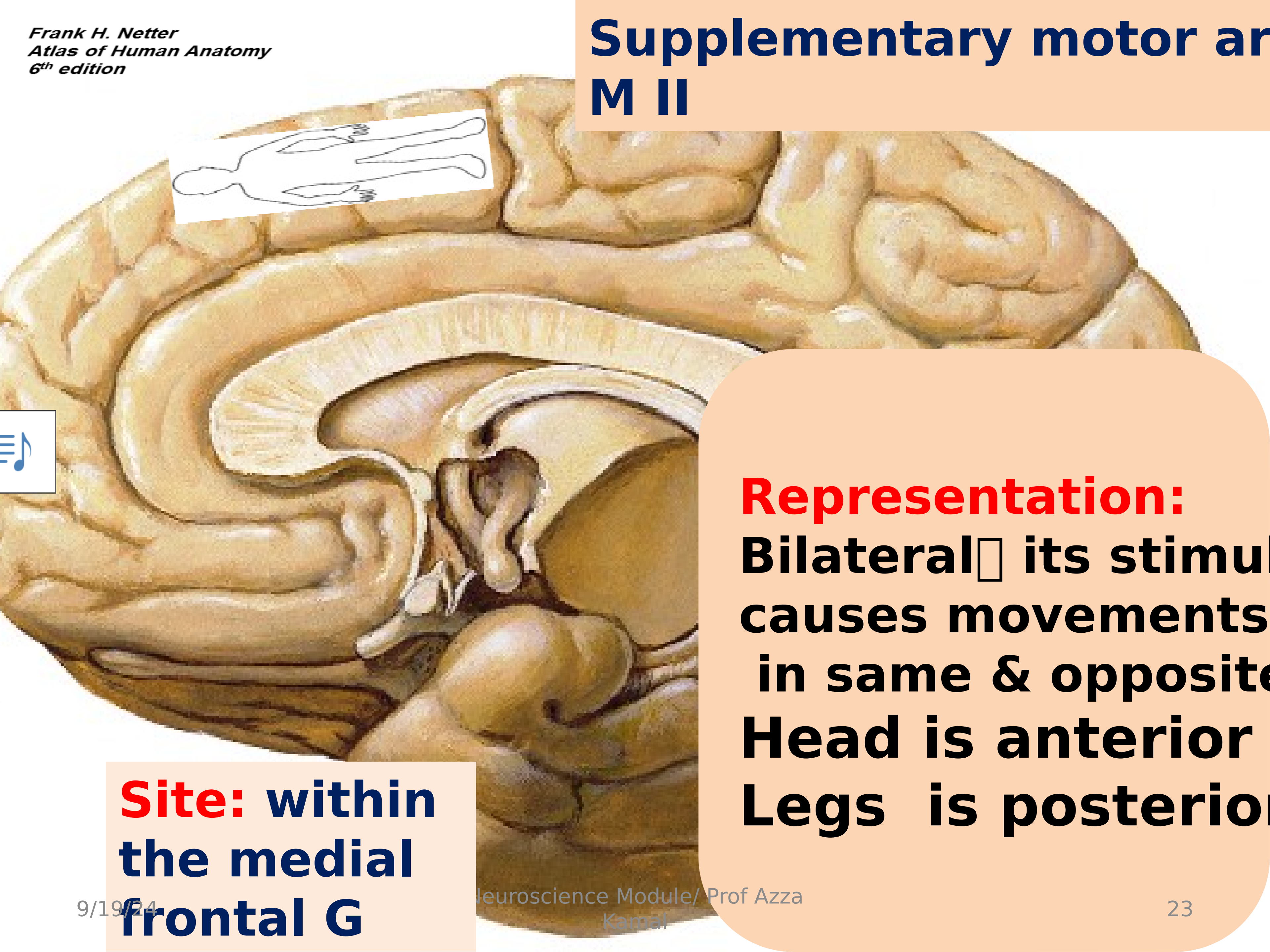
45

Lesion:

otor (expressive) aphasia

The patient cannot pronounce the words easily, but selects the proper words.


Medial frontal Gyrus
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Supplementary motor ar
M II
Representation:
Bilateral its stimul
causes movements
in same & opposite
Head is anterior
Legs is posterior
Site: within
the medial
frontal G

MII Function

- **It plans & stores programmes for difficult or complex movements for example movements involving both hands**

Bimanual movement



- **Contains a superior speech center**



- **Lesion** **temporary : aphasia & inability to move (Akinetic mutism) difficulty in performing complex**

SUMMARY

Precentral area

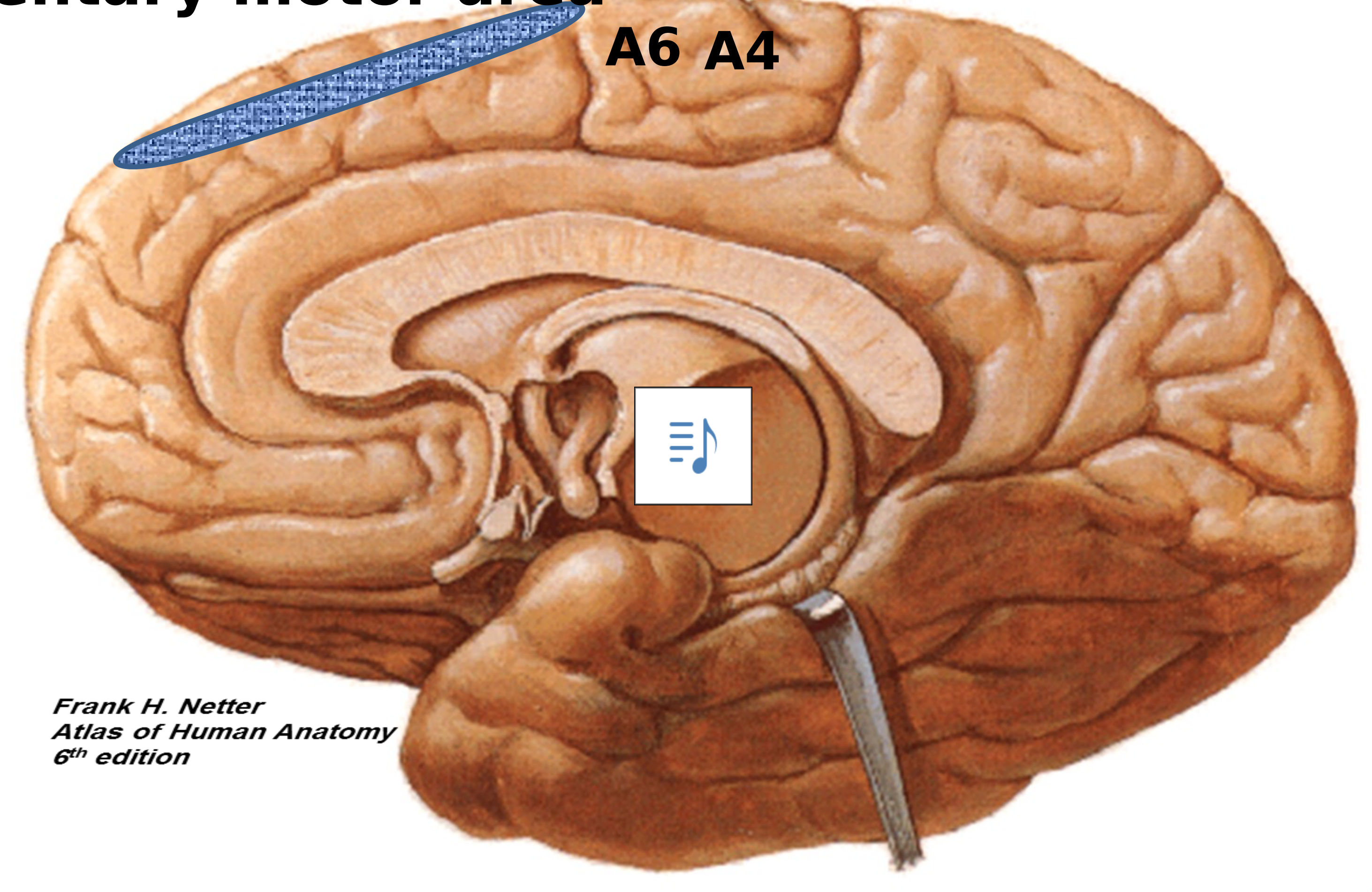
A8
A6
A4
44
45

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roca’s Area = Motor speech area

pplementary motor area



Prefrontal area

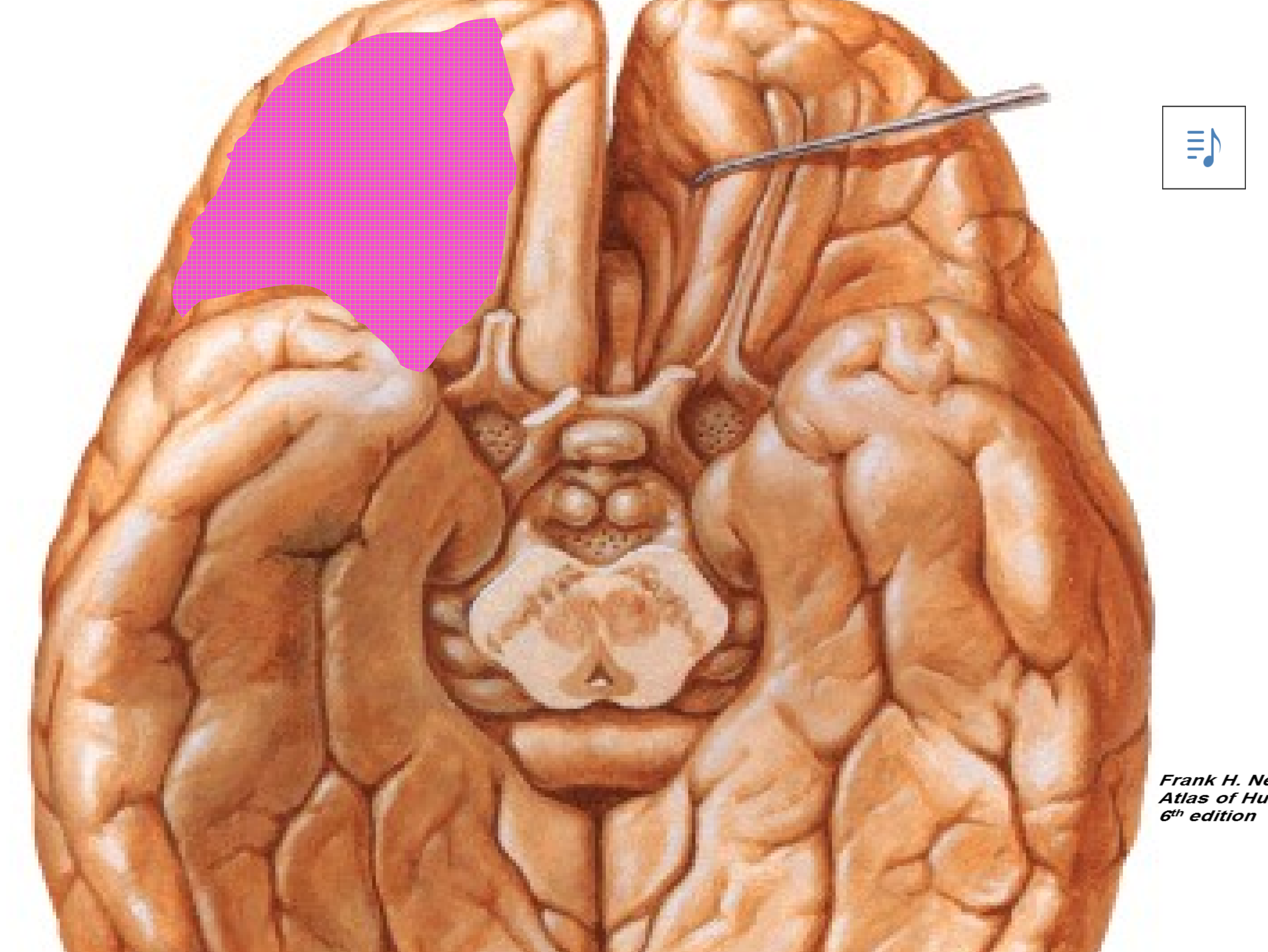


Prefrontal area

Site :

1)Remainder of sup., middle & inf. frontal gyri
2)Most of medial frontal gyrus
3)Orbital gyri

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Atlas of Hu
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Function

1) Intelligence
2) Expression of emotion
3) Ability to predict consequences of an action
4) Controls behavior ,mood & personality

Lesion

Changes in
Behavior, M
& Personalit

Broca’s area lies in which of the following sites?

A. Prefrontal area
B. Precentral gyrus
C. Superior frontal gyrus
D. Inferior frontal gyrus
E. Medial frontal gyrus

MCQ to test functional areas in the frontal lobe.

The Parietal Lobe



SI
First
Somatosensory
Area A3,1,2

SII
Second
Somatosensory
area

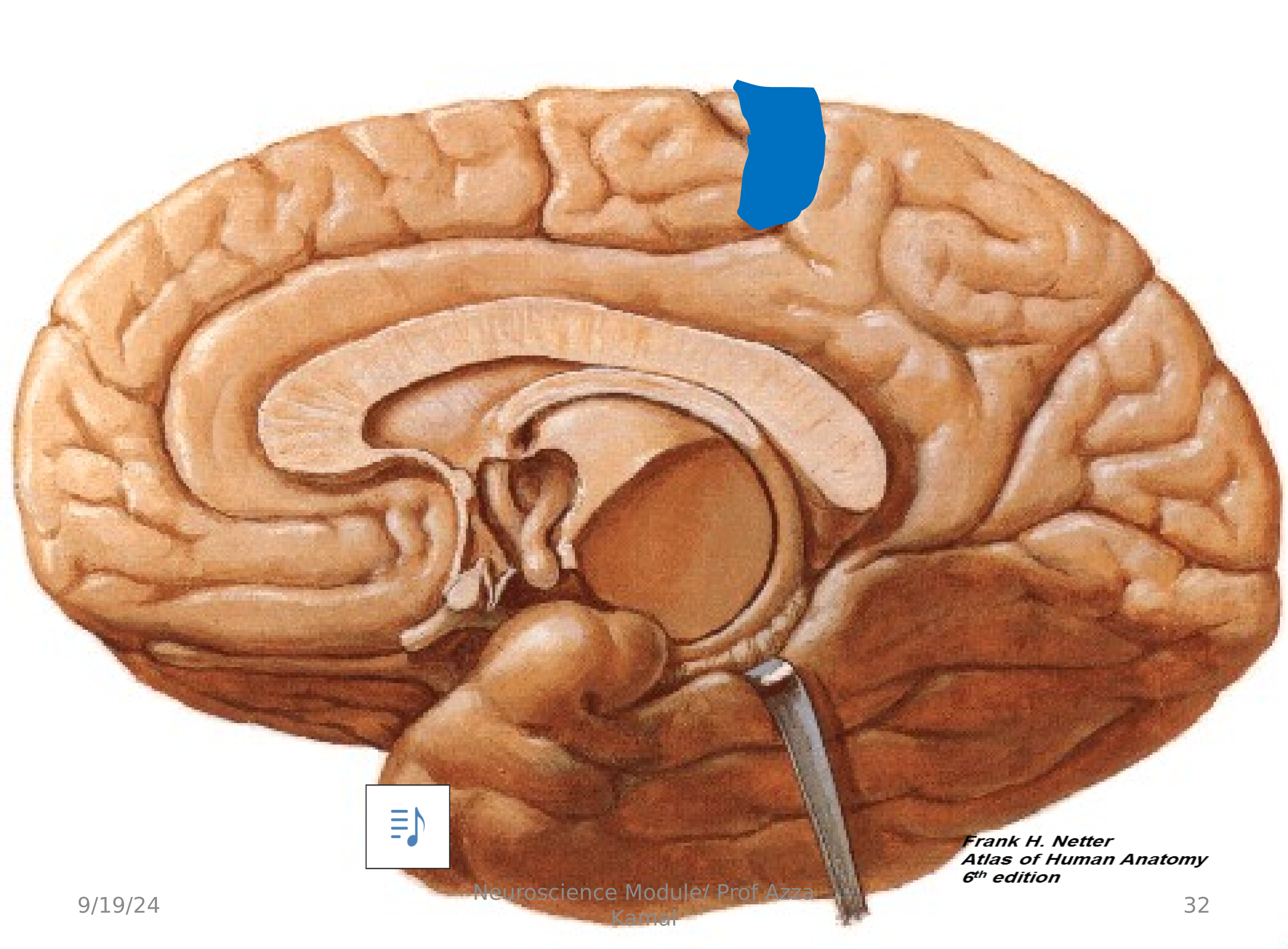
Taste area A43

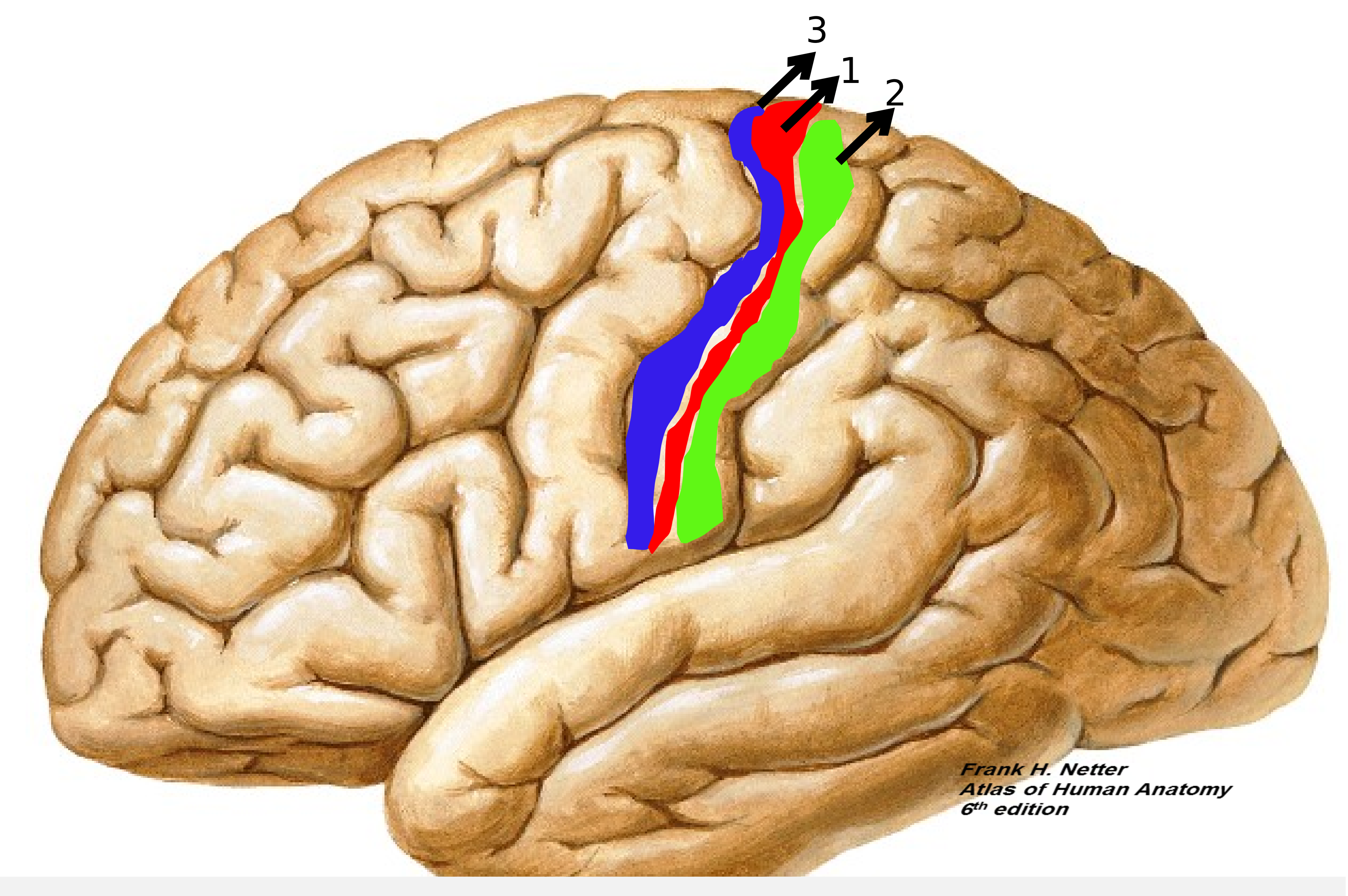
Superior parietal lobule

Inferior parietal lobule

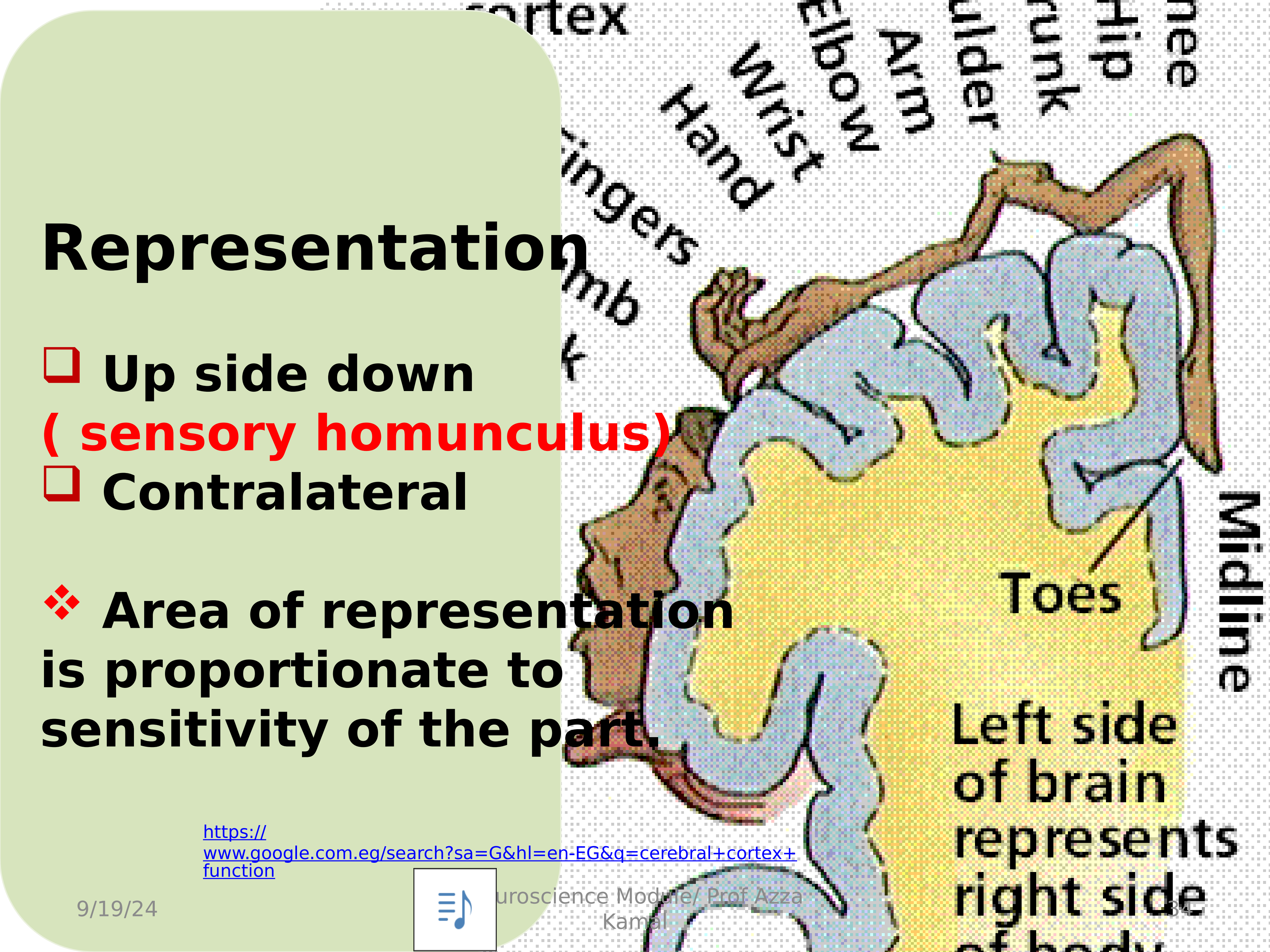
Site: post. central gyrus + post. part of paracentral

Site: superior lip of post. ramus of lat. sulcus behind central sulcus


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A3 , A1, A2 receive cutaneous & proprioceptive stimuli



Representation

- ❑ **Up side down** **(sensory homunculus)**
- ❑ **Contralateral**

❖ **Area of representation is proportionate to sensitivity of the part.**

https://www.google.com.eg/search?sa=G&hl=en-EG&q=cerebral+cortex+function

Function

of S1 area

receives

sensory impulse

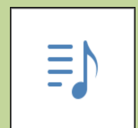
from thalamus

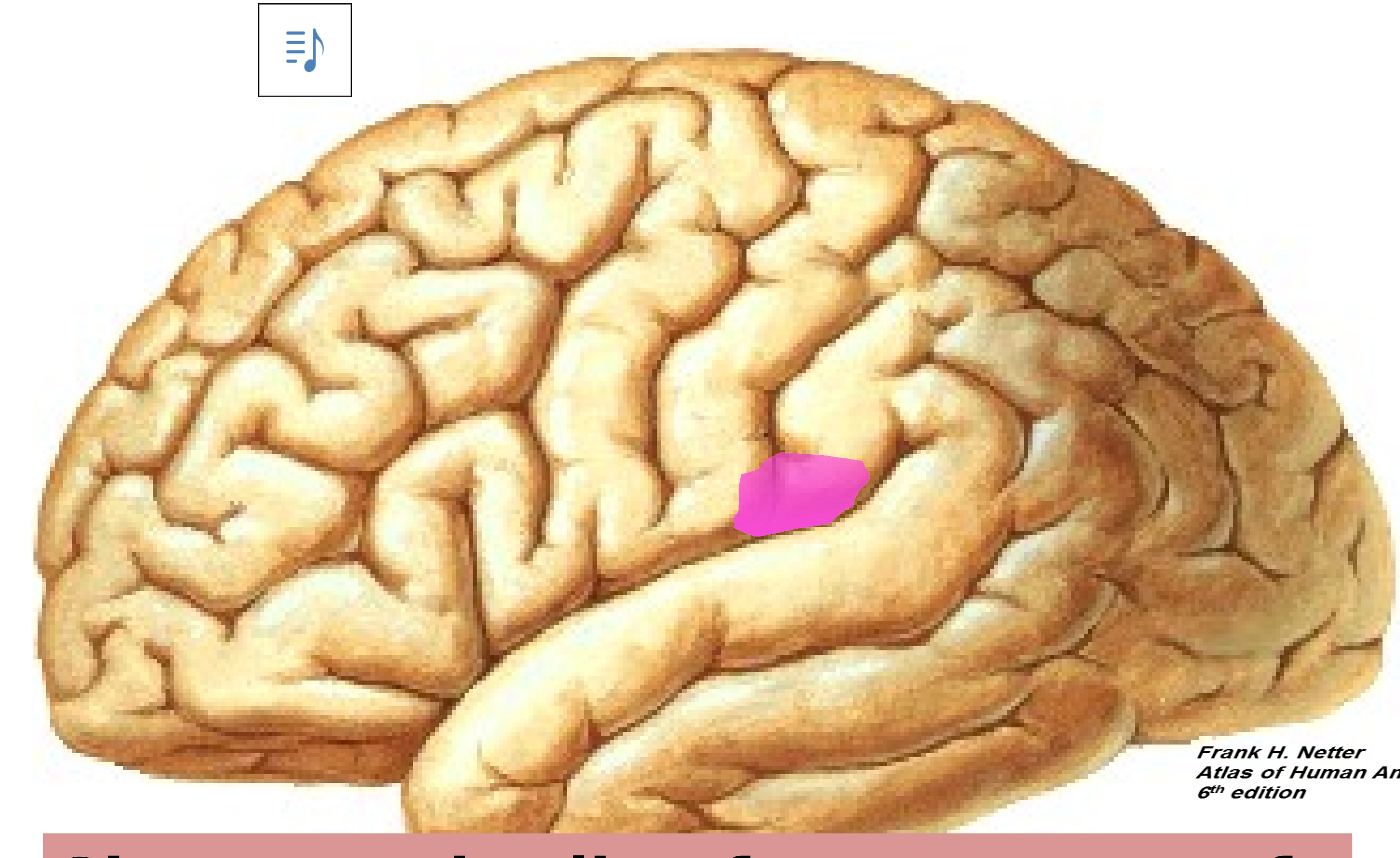
Lesion

Contralateral

Hemianesthesia

(impaired sensation of opposite side of body)





Site: superior lip of post. ramus of lat. sulcus , behind the central sulcus

SII

{Second somatosensory Area}

Representation: Bilateral

Head anterior
Legs posterior



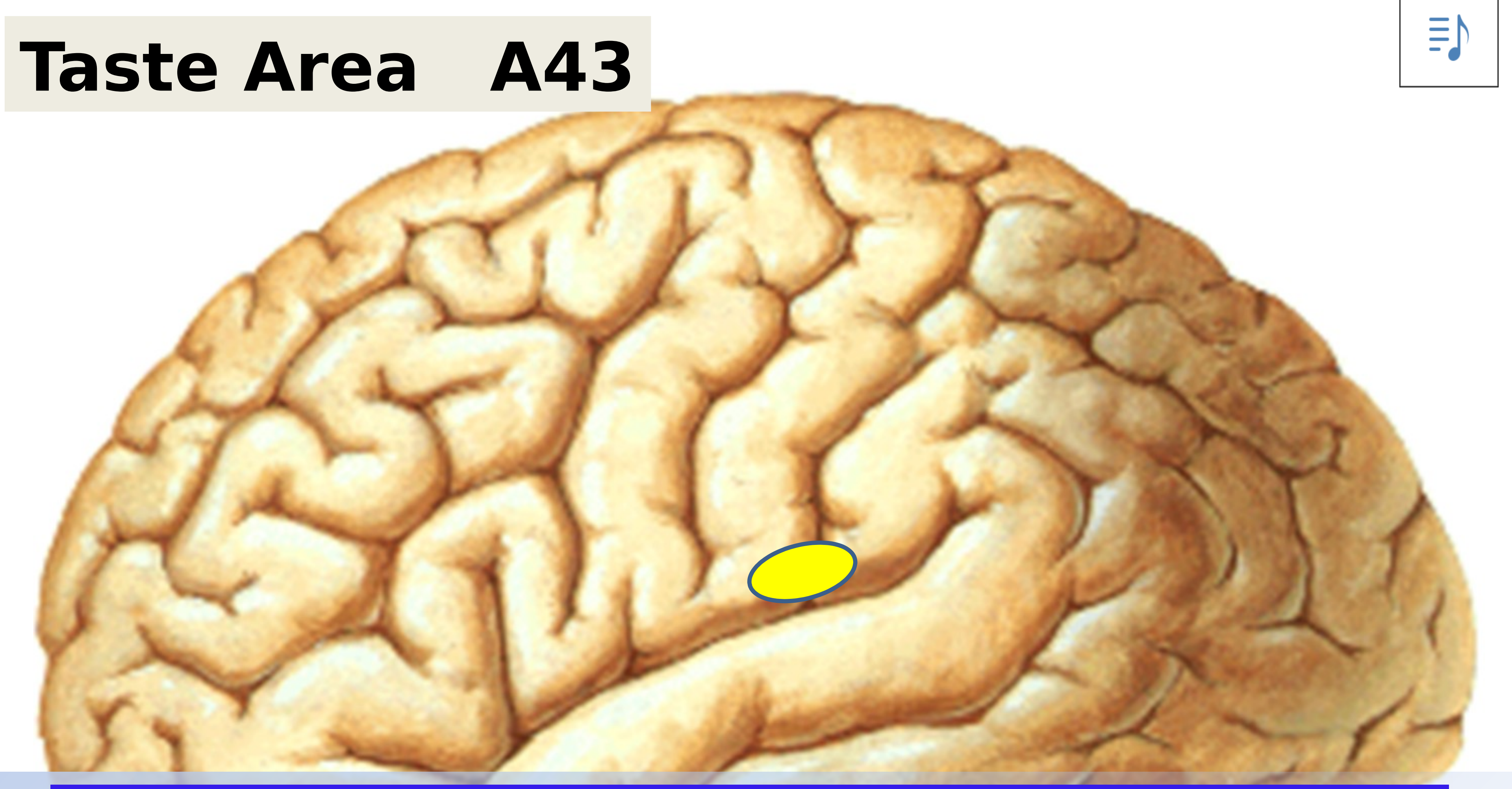
Function: Perception of transient sensory stimuli (brush stroke)




Lesion: No recognizable sensory loss



Taste Area A43



Receives ipsilateral solitario-thalamo cortical fibers from VPMN of thalamus

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5

7

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Function:

❖ Integrates sensation received from S1 & stor them as long term memories of past expe

❖ Contains Stereogn center

Lesion:

Astereognosis

(inability to recogni familiar objects by touch)





A 40 + A39 (inf parietal lobule)

+post part of sup temp Gyrus

+ post part of middle temp Gyrus (temporal lobe)

=Wernicke's area= sensory speech area

40

39



Wernicke's area is present only in the **dominant**





Function

Wernicke's area

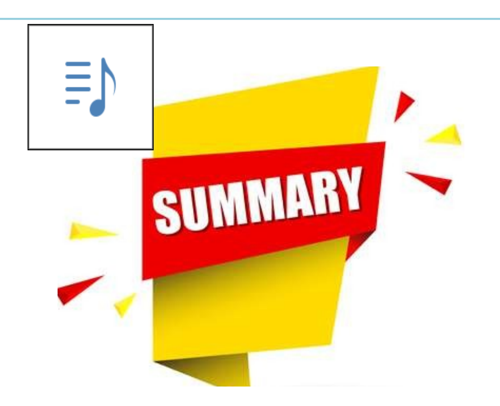
ensory speech area}

Responsible for
nderstanding speech
(heard or seen)

Lesion

Sensory
(receptive)
Aphasia patient ca
not understand
spoken or written wor

Important Note :

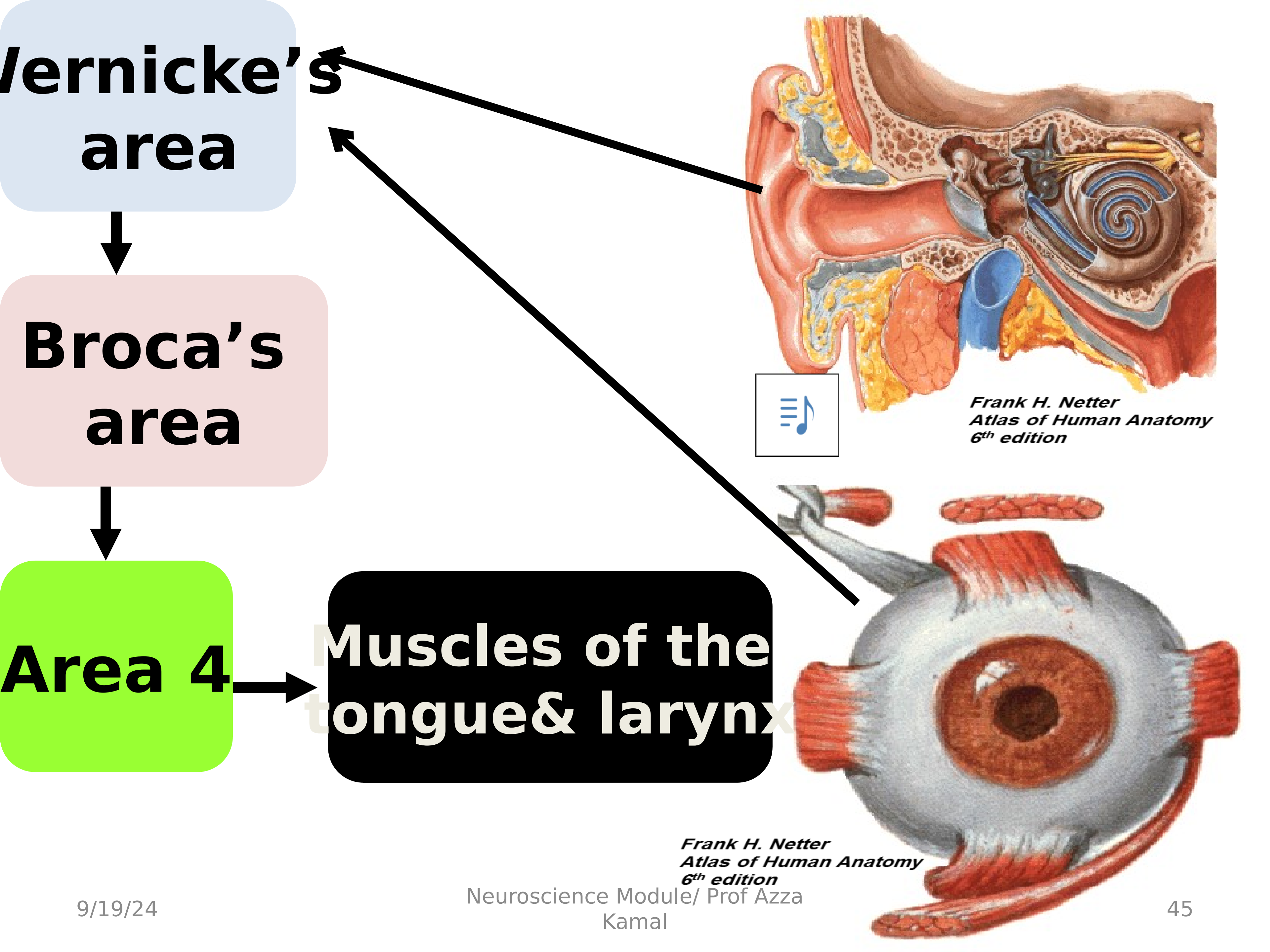


Speech center 3 are

1) Motor (anterior) speech center {Broca's area A44,45 }

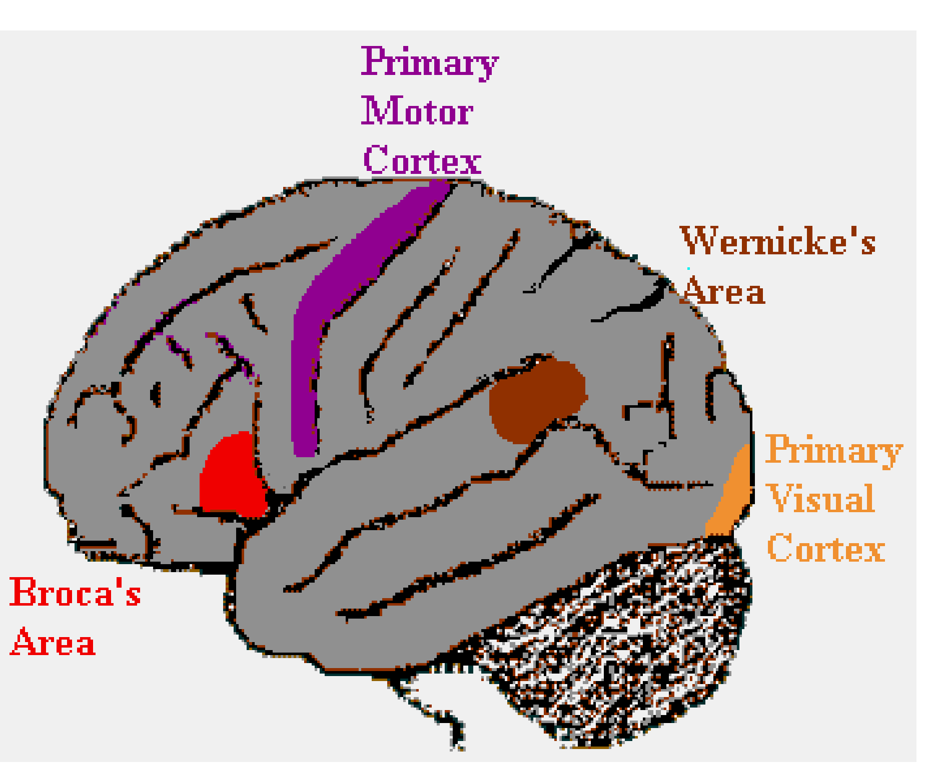
2) Sensory(posterior) speech center {Wernicke's area A39,40 }

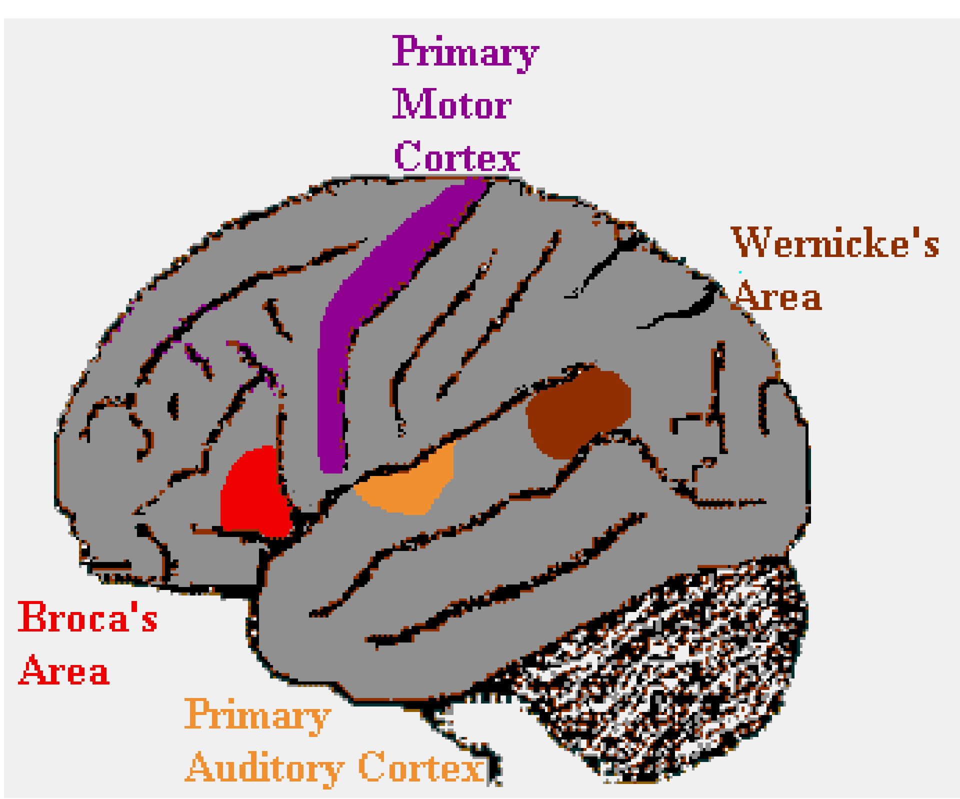
3) Third (superior) speech


Wernicke's area
Broca's area
Area 4
Muscles of the tongue& larynx
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peaking the seen word

Speaking the heard word

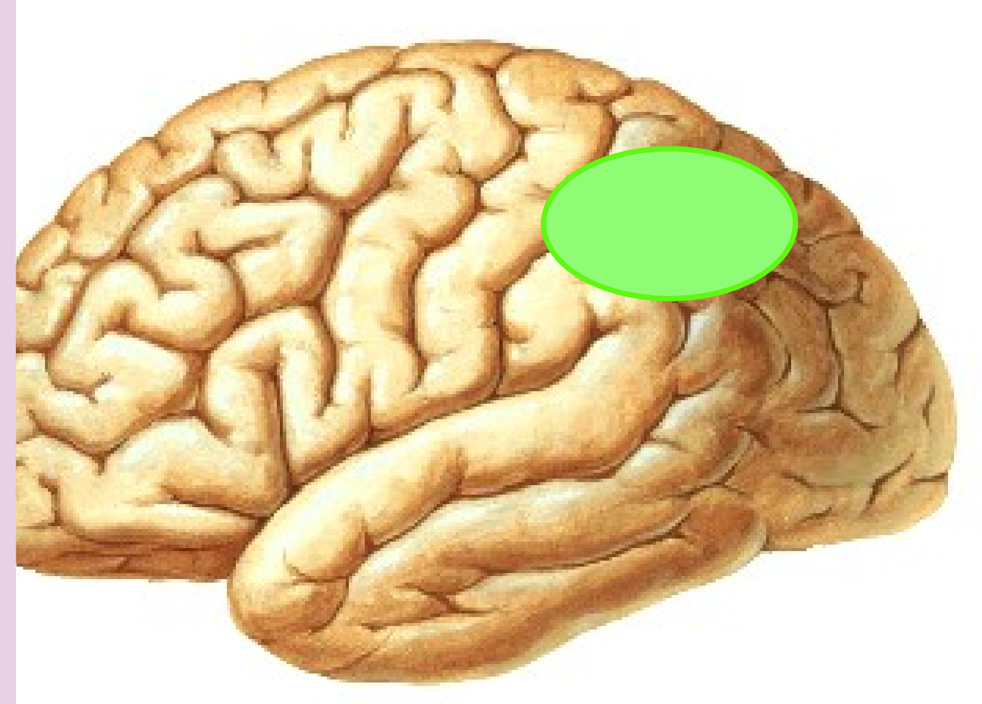


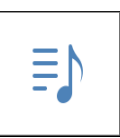


https://www.google.com.eg/search?sa=G&hl=en-EG&q=kids+coloring+book+brain

Parietal lobe recognizes orientation of contralateral half of body (awareness of body parts)

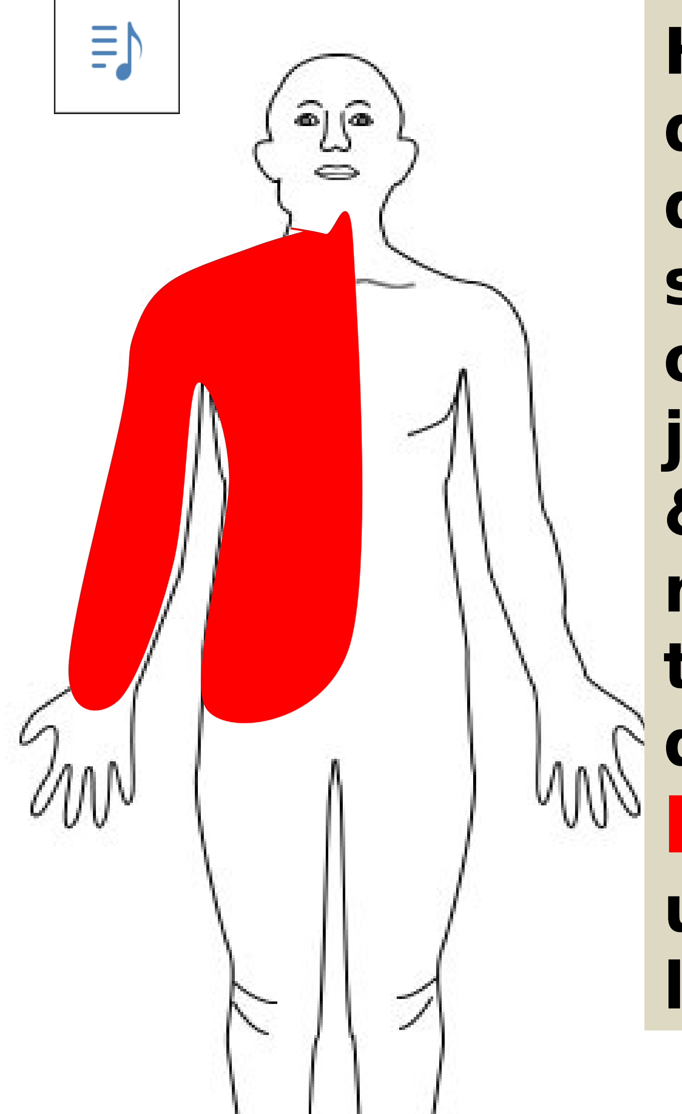
Lesion: sensory neglect (contralateral hemineglect) patient fails to recognize







https://www.google.com.eg/search?sa=G&hl=en



He dressed right sleeve of jacket & neglected to dress **left** upper limb

He shaved right side of beard & neglected **left** side

contralateral hemineglect

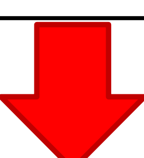
Usually lesion is manifest if right hemisphere (non dominant) is affected

Following a vascular stroke affecting the parietal lobe of the right cerebral hemisphere, a right handed patient is expected to complain from which of the following symptoms?

A. Motor aphasia
B. Inability to move his left arm
C. Inability to move his left foot
D. Inability to recognize opposite side of body as its own.
E. Changes in behavior and personality

MCQ to test Functional areas and lesions of Parietal lobe

Temporal lobe

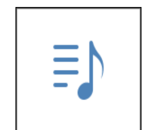


Primary Auditory Area A 41, 42

Secondary Auditory Area A 22

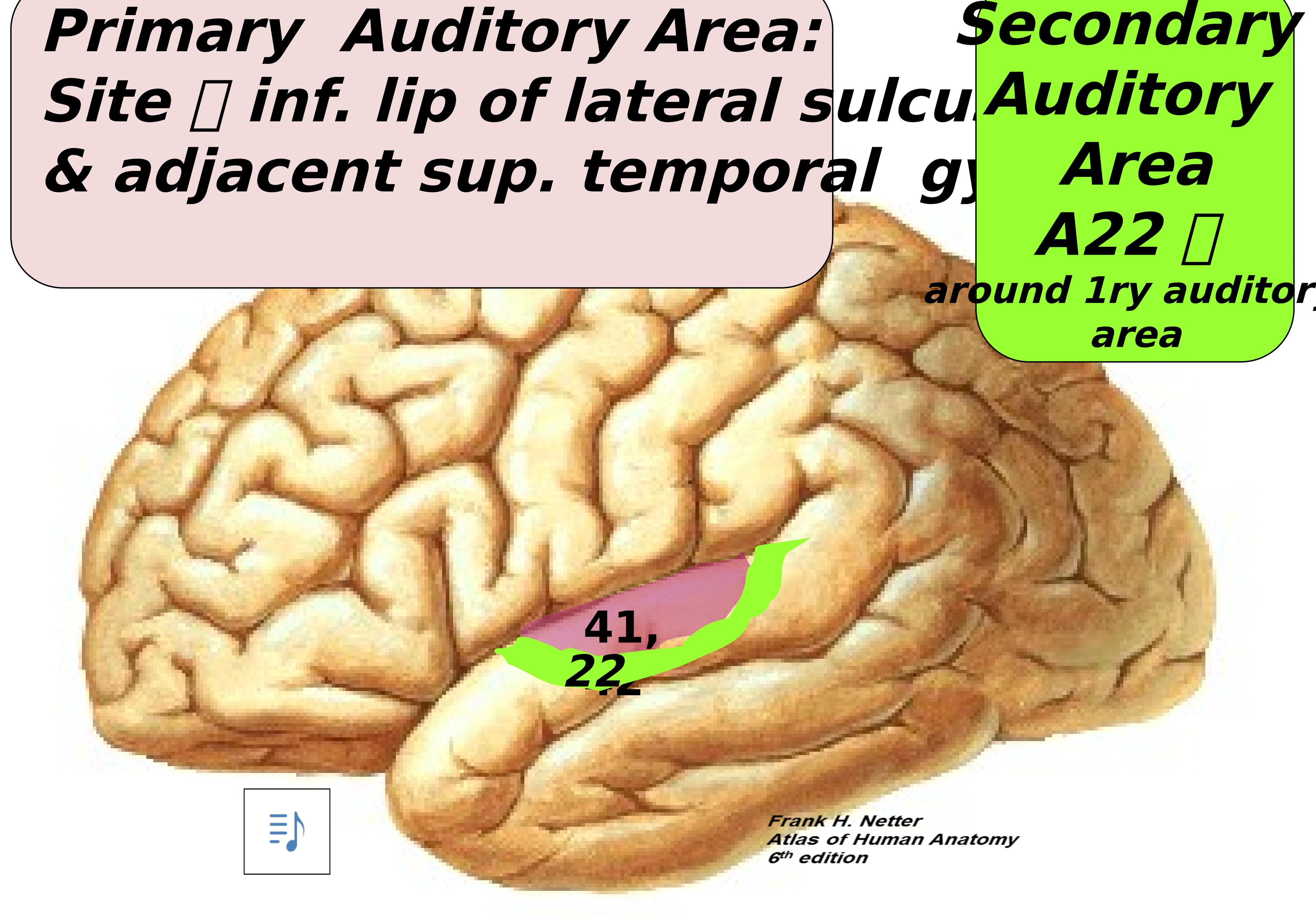
Facial recognition area

Part of :
-Wernicke's Area
-Vestibular area
-Olfactory areas



Primary Auditory Area:
Site inf. lip of lateral sulcus & adjacent sup. temporal gyrus

***Secondary Auditory Area A22 ***
around 1ry auditory area



Primary Auditory Area(A41,42)

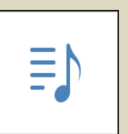


unction : perceptio hearing from both ea

Lesion :

impaired hearing not loss because ochlea is bilaterall represented

Secondary Auditory Area (A22)



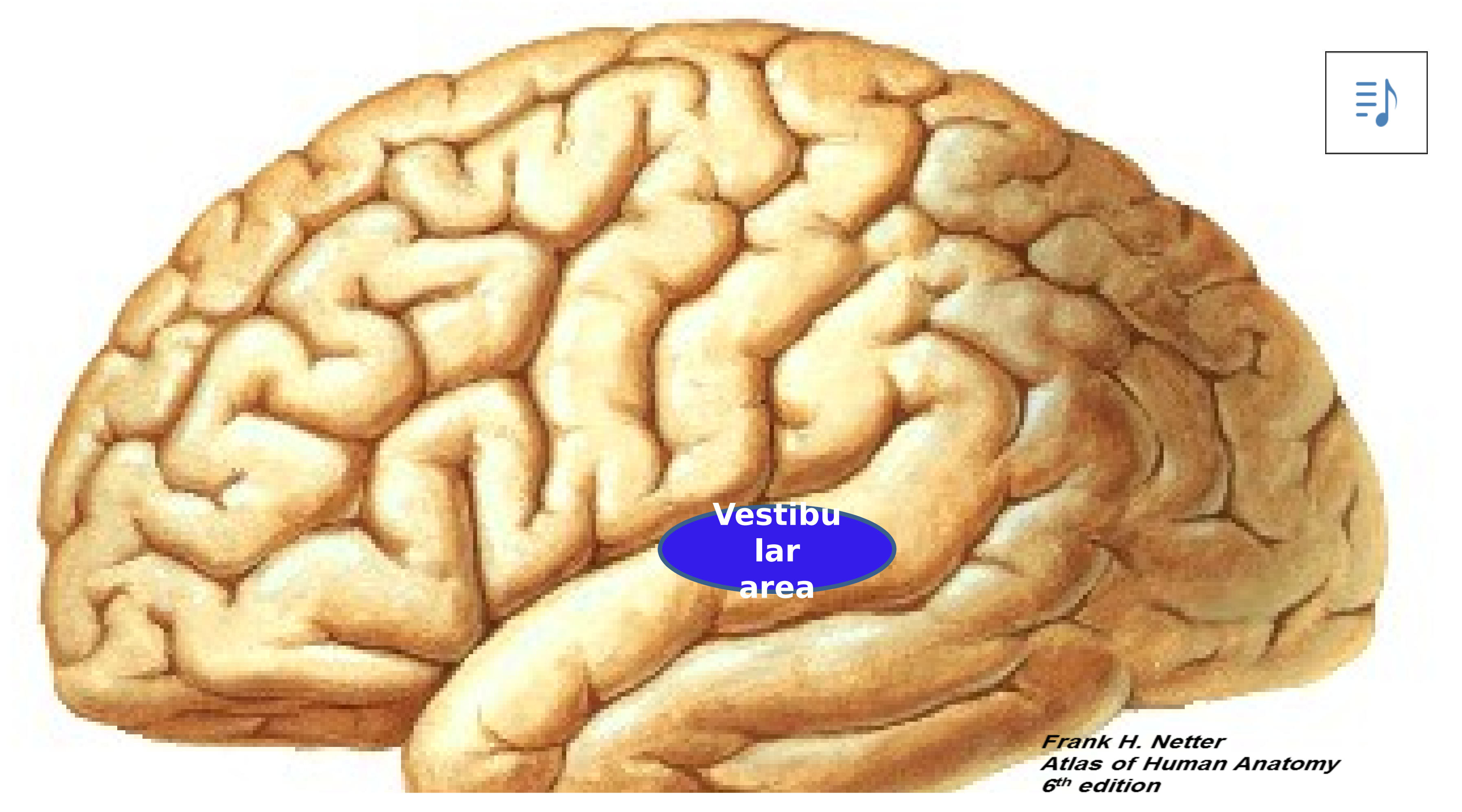
Function :

understands auditory stimuli by associating them with past experien

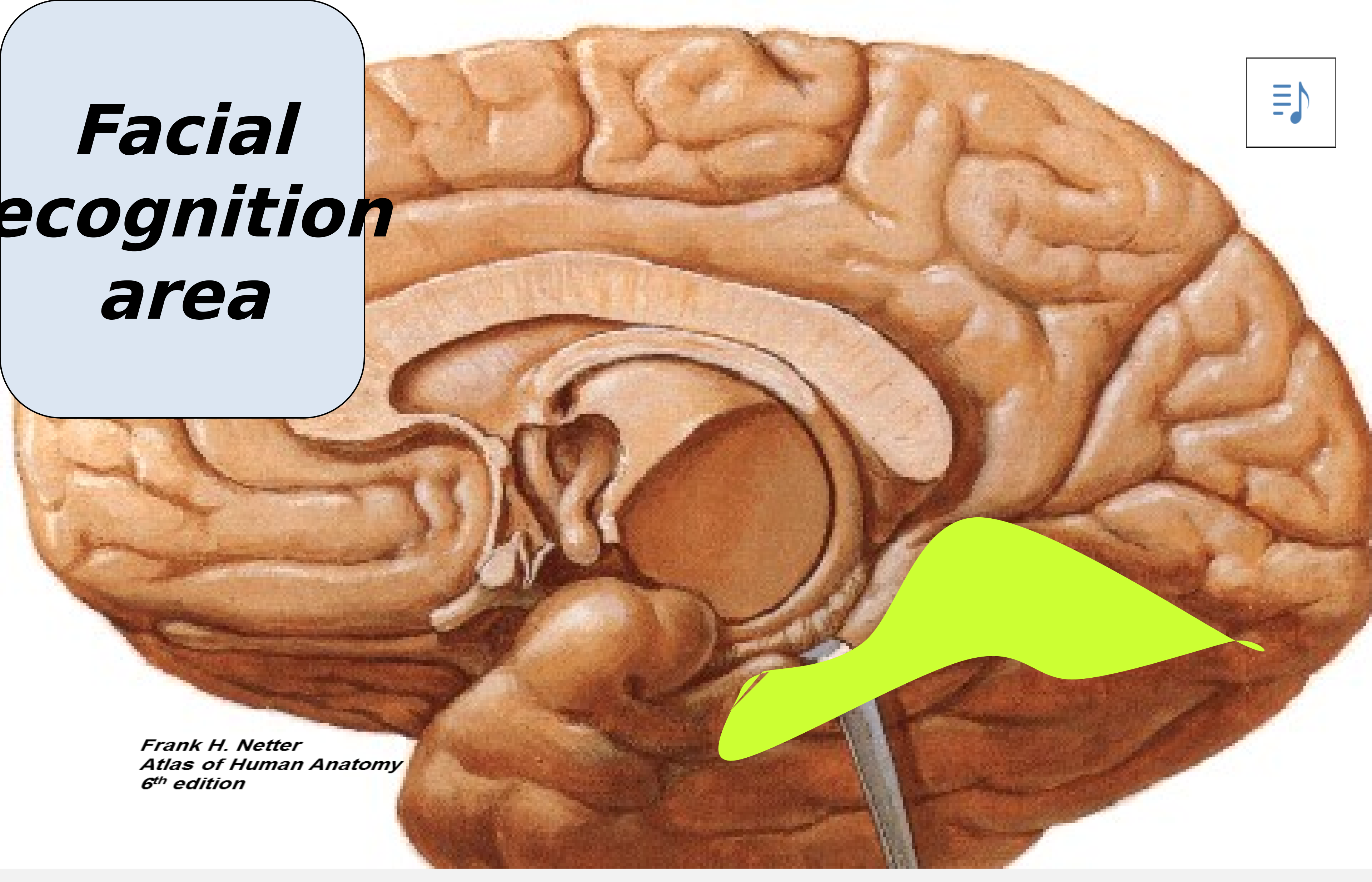
Lesion :

auditory verbal agnosi (inability to understand sou

estibular area : close to auditory area

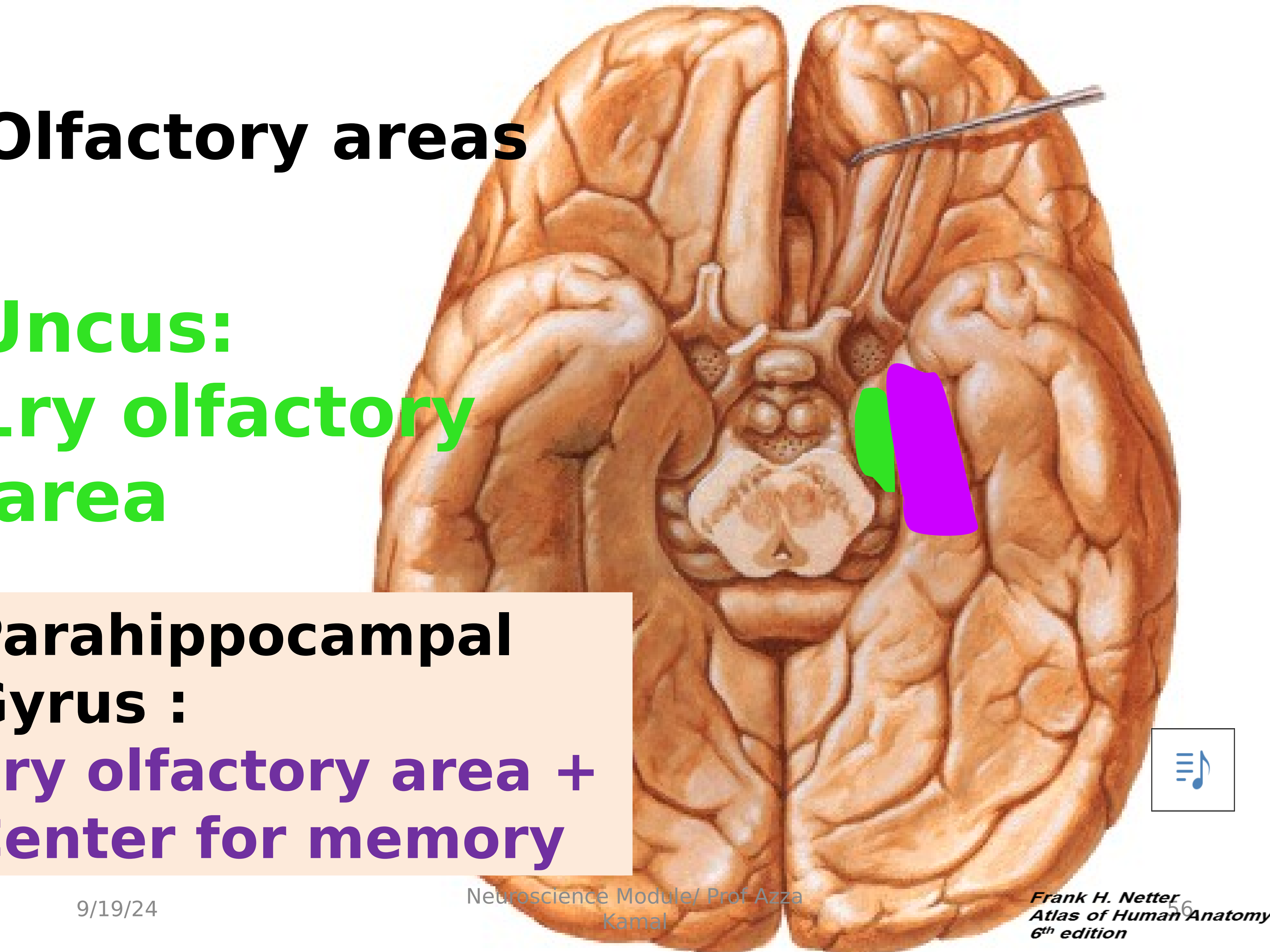


ves information about head position & movem
vestibular nuclei



nf. surface of temporal & occipital lo



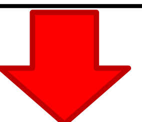

Olfactory areas
Uncus:
1ry olfactory
area
Parahippocampal
Gyrus :
2ry olfactory area +
center for memory
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Atlas of Human Anatomy
6th edition

A patient complains of inability to understand sounds. This is known as which of the following?

A. Sensory aphasia
B. Verbal agnosia
C. Prospagnosia
D. Impaired hearing
E. Anosmia

MCQ to test Functional areas and lesions of Temporal lobe

The occipital lobe

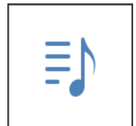


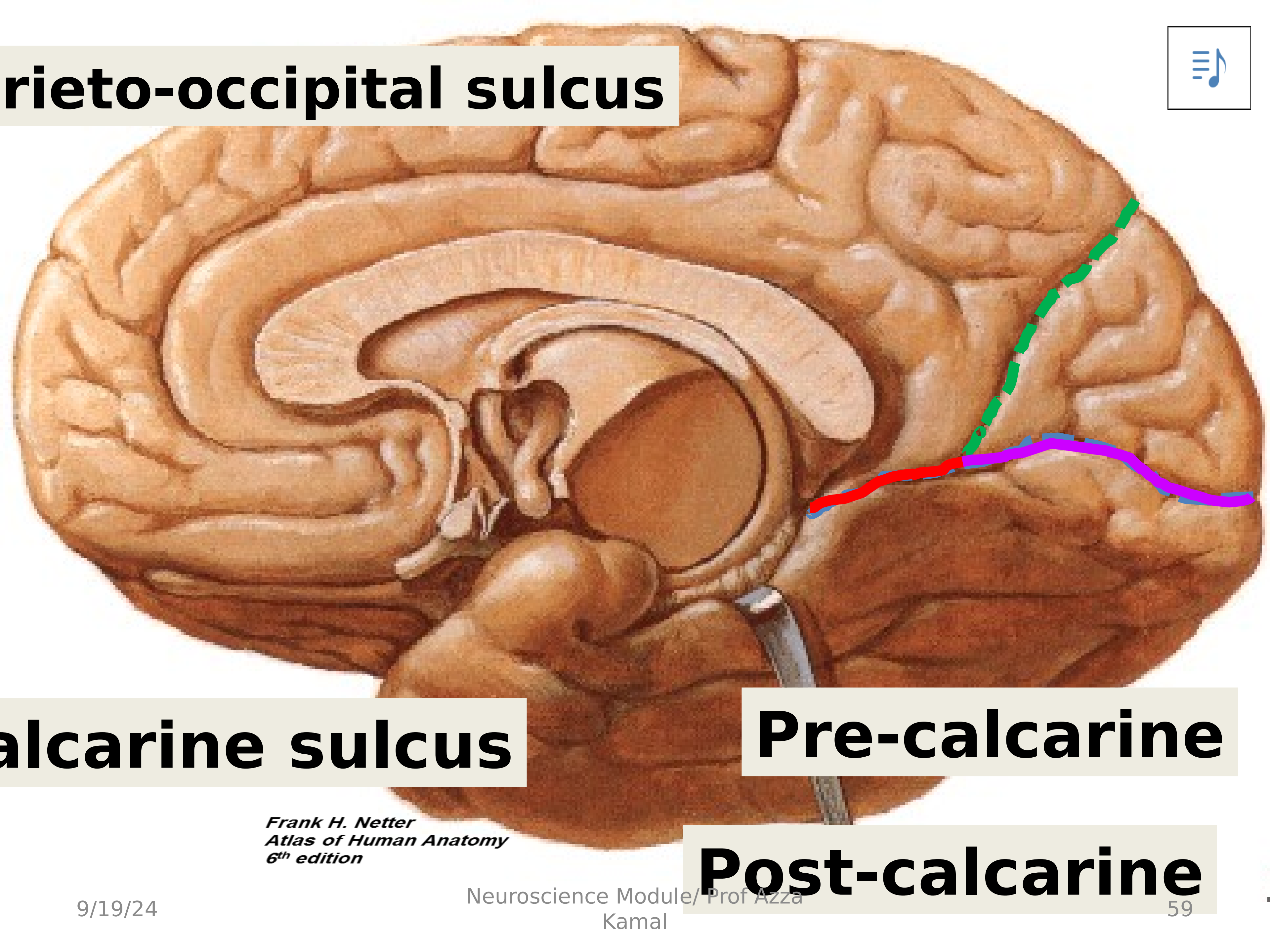
Primary visual Area A17

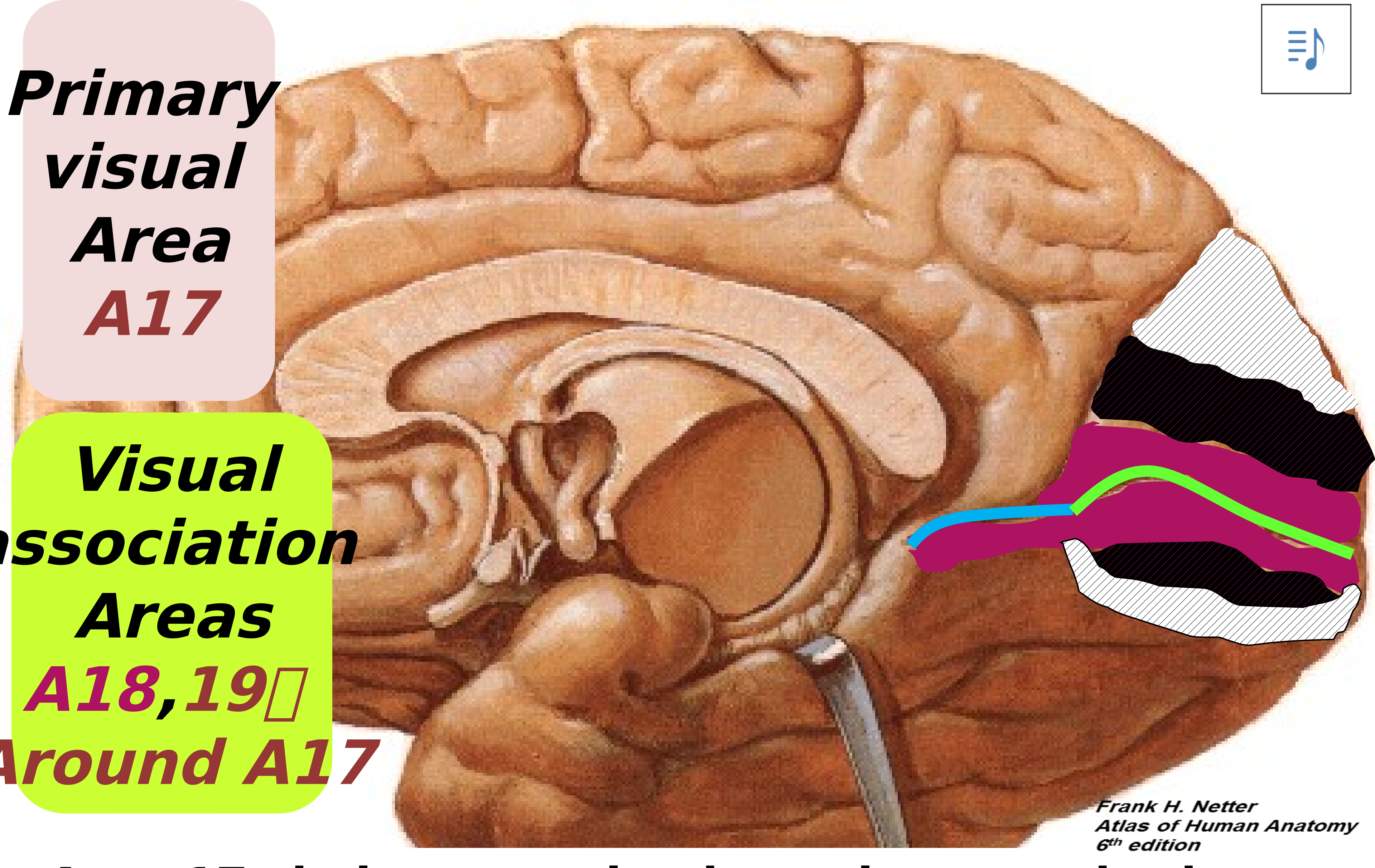
Visual association Areas A18,19

Part of Facial recognition area

Occipital Eye field




rieto-occipital sulcus
alcarine sulcus
Pre-calcarine
Post-calcarine
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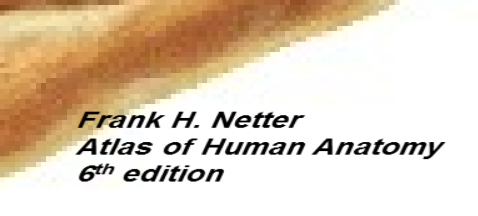


Area 17 below precalcarine sulcus+ on both sides of postcalcarine sulcus+ extends on lat. surface till lunate sulcus



Primary visual Area A17

Visual ssociation Areas A18,19

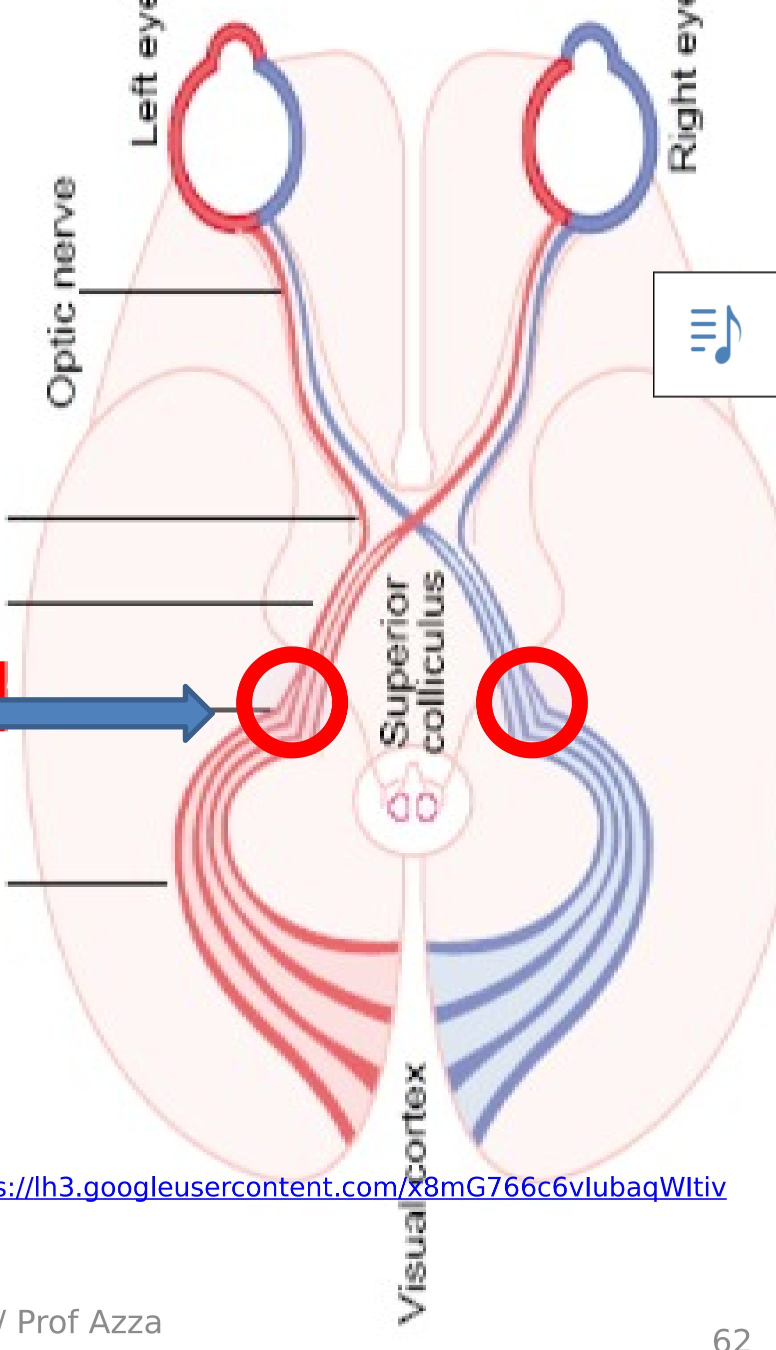


Primary visual Area(A17)

unction : perception of vision

ceives stimuli from LG
(lat.geniculate body)

esion : Homonymous Hemianopia
loss of opposite field of vision)

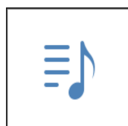


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Visual Association Areas(A18,19)

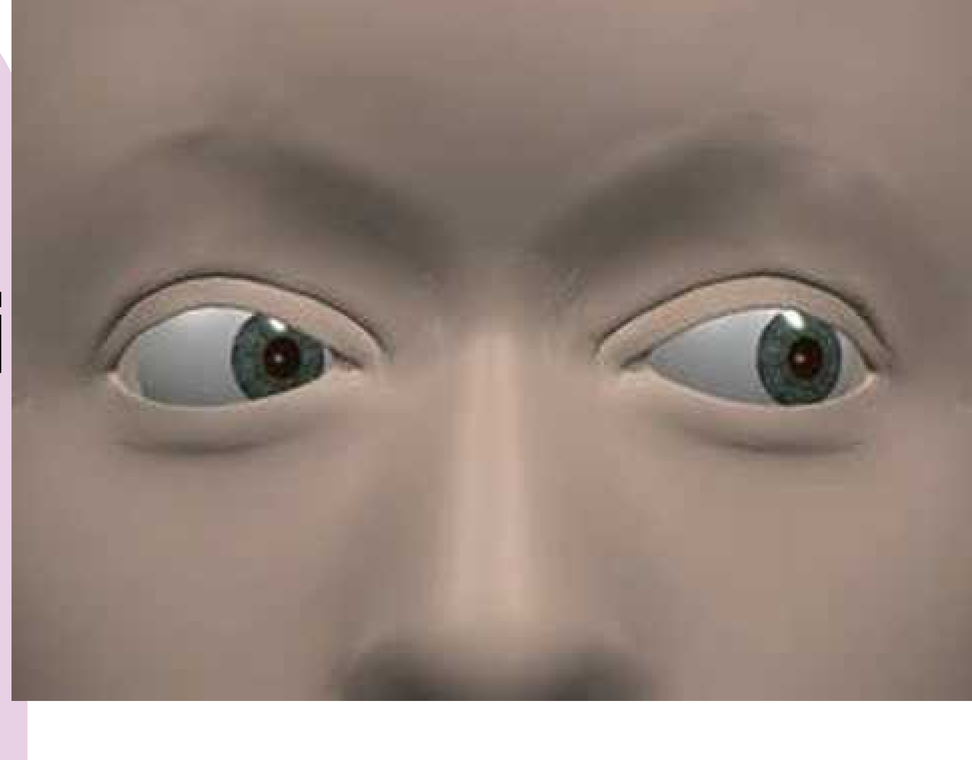
Function : **stores past visual experience to identify objects & help discriminate colors**

Lesion □ visual agnosia (patient can see BUT can not identify what he sees)



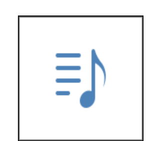
Occipital Eye fi

Site : in A17 &



Responsible for Involuntary (reflex) Conjugate eye movement





Cerebral Asymmetry

ht & left hemispheres are
identical as regards sulci &
.
eech areas are present in
hemisphere only
ninant Hemisphere)
% of people are right -handed
those ,the left hemisphere
ne Dominant hemisphere.
% of people are left-handed &
are mixed -handed and in both,
ight or left hemisphere may be dominant

https://lh3.googleusercontent.com/TJ78aQuCpAMzkoBVAWTV

Which of the following functional areas of the cerebral hemispheres lies below the pre-calcarine sulcus, on both sides of post-calcarine sulcus and extends on the lateral s l the lunate sulcus ?

A. Primary visual area

B. Visual association area

C. Primary auditory area

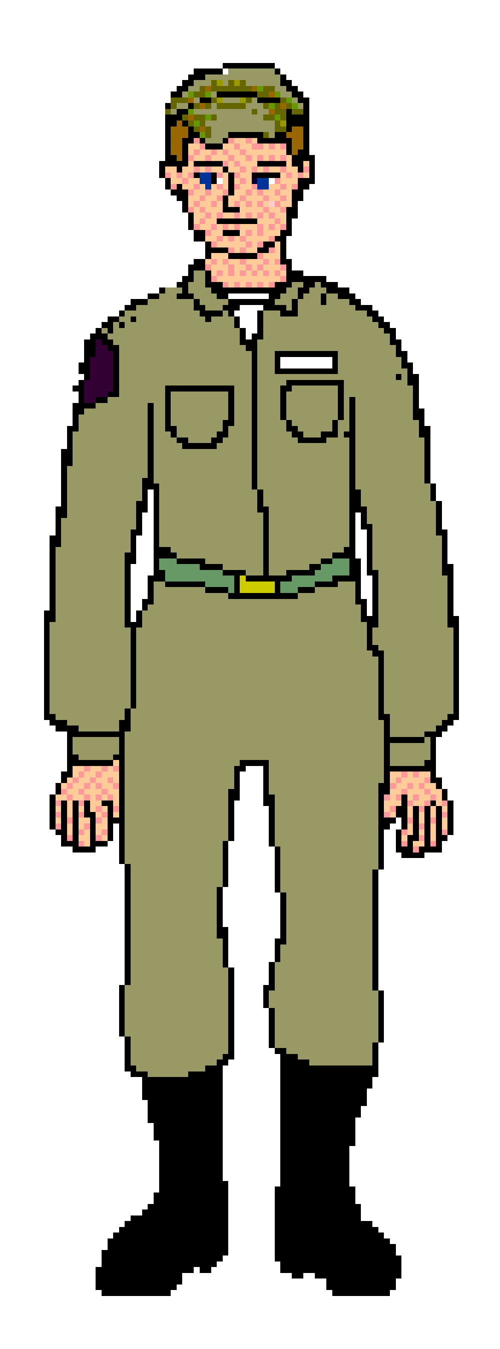
D. Olfactory area

E. Facial recognition area

MCQ to test Functional areas and lesions of Occipital lobe.



Thank You



<u>Reference:</u>
Clinical Neuroanatomy, Richard Snell, 7th edition
Functional areas : Pages 288-295